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INFRAMEET2022

INTERNATIONAL MEET ON INFRASTRUCTURE AND CONSTRUCTION

NOVEMBER 10-12, 2022 | CHICAGO, USA

ALBEDO MEETINGS
Floor# 3, Advant Building, 99B, Kakatiya Hills, Kavuri Hills, Madhapur Hyderabad, TS 500033
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FOREWORD

Welcome Message

On behalf of the Organizing Committee, it is my pleasure to welcome all the participants of the International Meet on Infrastructure and Construction (INFRAMEET2022) - a conference on infrastructure and construction to be held in Chicago, USA on November 10-12, 2022.

Infrastructure and construction is a discipline in civil engineering which has a specific goal of understanding the structure and properties of all kinds of materials. It is a very broad and lively area of research in infrastructure in the mining industry, civil engineering, water resource engineering, landscape design, geotechnical engineering, planning, architecture, and design.

Due to intense research all over the world in the infrastructure and construction area, new ideas and novel materials are created every now and then. Needless to say, today construction is one of the main pillars of high technology. In this highly active area INFRAMEET2022 intends to cover a few selected topics to be presented by well-known experts in this field. We also encourage young researchers to participate, present their recent research work and interact with other co-participants.

Prof. Zhanping You, P.E., Ph.D., F.ASCE, F.EMI
Chair, INFRAMEET2022
Michigan Technological University
USA

COMMITTEES

Organising Committee

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Manoj Khandelwal	Federation University, Australia

Plenary Forum

Evolutionary Intelligence in Civil Infrastructures

Amir H Gandomi
University of Technology Sydney, Austriala

Abstract

Evolutionary Computation (EC) has been widely used during the last two decades and has remained a highly-researched topic, especially for complex engineering problems. The EC techniques are a subset of artificial intelligence, but they are slightly different from the classical methods in the sense that the intelligence of EC comes from biological systems or nature in general. The efficiency of EC is due to their significant ability to imitate the best features of nature which have evolved by natural selection over millions of years. The central theme of this presentation is about EC techniques and their application to complex infrastructure problems. On this basis, first I will talk about an evolutionary approach called genetic programming for data analytics. Applied evolutionary computing will be presented, and then their new advances will be mentioned. Here, some of my studies on big data analytics and modelling using EC and genetic programming, in particular, will be presented. Case studies' are key applications in the design optimization of complex and nonlinear engineering systems. It will also be explained how such algorithms have been adopted to civil engineering problems and how their advantages over the classical optimization problems are used in action. Optimization results of large-scale towers and many-objective problems will be presented which show the applicability of EC. Some heuristics will be explained which are adaptable with EC and they can significantly improve the optimization results.

Biography

Amir H. Gandomi is a Professor of Data Science and an ARC DECRA Fellow at the Faculty of Engineering & Information Technology, University of Technology Sydney. Prior to joining UTS, Prof. Gandomi was an Assistant Professor at Stevens Institute of Technology, USA and a distinguished research fellow in BEACON center, Michigan State University, USA. Prof. Gandomi has published over two hundred journal papers and seven books which collectively have been cited 24,000+ times (H-index = 72). He has been named as one of the most influential scientific minds and Highly Cited Researcher (top 1% publications and 0.1% researchers) for five consecutive years, 2017 to 2021. He also ranked 18th in GP bibliography among more than 12,000 researchers. He has served as associate editor, editor and guest editor in several prestigious journals such as AE of IEEE TBD and IEEE IoTJ. Prof Gandomi is active in delivering keynotes and invited talks. His research interests are global optimisation and (big) data analytics using machine learning and evolutionary computations in particular.

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Seismic Metamaterials with Low Frequency Wide Bandgaps Using Steel Barriers

C.W. Lim*
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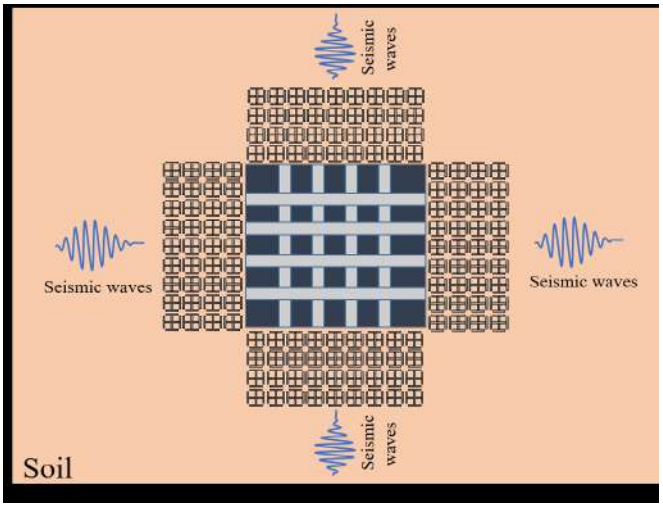
Abstract



The feasibility of built-up steel section as barriers of seismic metamaterials is proposed in this study. We consider two types of built-up steel sections (as resonators) and the surface waves propagation in a singlelayer homogenous medium and a six-layered soil medium (substrate) is investigated by analytical and computational techniques. The presence of resonator on the surface of a semi-infinite substrate results in the generation of local resonance that induces low frequency wide bandgaps. The generation of local resonance bandgaps are mainly governed by the impedance mismatch between resonator and substrate and the coupling of surface waves propagating on the surface of a semi-infinite substrate with a longitudinal mode of resonator. We further consider the surface waves propagation in both types of media and compared the bandgap frequencies. For layered soil media, a bandgap with relative bandwidth greater than 1.5 is reported that indicates the surface wave bandgap is relatively wide and it is located at a low frequency. The result also shows the effect of impedance mismatch on the bandgap width. Furthermore, with a change in geometric parameter of the resonator and material properties of substrate, theposition and width of bandgap do vary. The infinite unit cell model study is further validated by a finite unit cell based frequency response and time transient analyses. An excellent agreement is observed. The time transient analysis results indicate more than 50% reduction in vibration amplitude of the surface waves. The study provides an insight for having steel piles to protect critical infrastructures from earthquake hazards.

Deep Learning for Damage/Defect Detection for Infrastructure Systems

Young-Jin Cha*
University of Manitoba, Canada

Abstract

Civil infrastructures in north America have been graduated deteriorated, and there are increased number of sudden collapses of the bridge systems. In order to prevent these catastrophic failures, traditional contact sensor-based approaches have been proposed and implemented to existing infrastructure system. However due to uncertainties related to sensory system noises and environmental effects such as humidity and temperature, the damage detection methods could not detect damage accurately. Therefore, to overcome this critical limitation, the presenter proposed a deep learning-based damage detection using computer vision. In this presentation, Dr. Cha will introduce some state-of-the-art methods in deep learning-based damage segmentation method in pixel level in complex background scenes. As the methods a semantic damage detection network (SDDNet) and a semantic transformer representation network (STRNet) will be introduced and these will be integrated with an autonomous flight method of the unmanned aerial vehicles (UAVs). This automated system will detect multiple types of damage accurately in pixel level with real-time processing of the UAV videos.

Transform Waste Tire Rubber to Better Asphalt Pavement: Design and Construction

Zhanping You*, P.E., Ph.D., F.ASCE, F.EMI
Distinguished Professor
Director, Graduate Programs
Civil and Environmental Engineering
Michigan Technological University

Abstract

Stockpiles of waste tires pose concerns of potential contamination of local groundwaterand fire risk from the massive amounts of tires. To properly use the waste tires, tire rubber recycled from waste tires has been used in the pavement industry for decades. However, the function of such recycled tire rubber in the internal structure of asphalt mixtures was not fully understood. This study attempted to establish discrete element models(DEM) to investigate the strength, skeleton structures, and stress distribution of rubber modified asphalt mixtures. New modeling procedures were developed to incorporate coarse aggregate shapes and rubber particles. Indirect tensile strength (ITS) of specimens with rubber materials were tested in the laboratory and also modeled in simulations. The internal structure and stress distribution of specimens with different rubber contents were analyzed. The gap gradation was proved to have a functional capacity of accommodating fine aggregates and rubber particles, all while forming a coarse aggregate skeleton. The research team also expanded the research work from models and lab work to field pilot projects. Quite a few pilot projects that usedrecycled tire rubber were constructed as asphalt pavements in Michigan (MI).

Biography

Zhanping You

Dr. Zhanping You earned his Ph.D. in Civil Engineering from the University of Illinois at Urbana - Champaign in 2003. After serving years of faculty positions in the Department of Civil and Environmental Engineering at Michigan Technological University, he was promoted to Professor in 2014 and earned a Distinguished Professorship in 2019.

Dr. You has completed research projects related to road materials, pavement engineering, and sustainable building materials. His contribution to pavement and materials research has led to journal articles, book chapters, and advances in engineering practice. He has led research projects from engineering practice of roads to pavement science with funding from federal, state, and local agencies.

Dr. You has received numerous recognitions. He was awarded U.S. Department of Transportation's Dwight David Eisenhower Transportation Fellowship in 2001. In both 2004

and 2005, he was awarded the Dwight David Eisenhower Transportation Faculty Fellowship. He earned the prestigious Michigan Tech Research Award in 2019 and University Distinguished Professorship. He was named as Fellow of American Society of Civil Engineers (ASCE) and Fellow of the International Association of Advanced Materials in 2020. Dr. You served as the Chair to ASCE Engineering Mechanics Institute's Pavements Committee and CI's Bituminous Materials Committee. He is also the guest editor for other journals outside of ASCE.

Advanced Cement-Based Materials for Ocean Civil Structures

Zongjin Li*
University of Macau, China

Abstract

Ocean civil structures are usually stood in severer environmental conditions while carrying the complicated loading. For such structures, special requests for construction materials are necessary to ensure their serviceability and durability. In this talk, the nature of the severer environmental and loading conditions in ocean will be examined and properties of concrete structures to resist such conditions be investigated first. Then,the scientific background for design the advised cement-based materials, including mortar and concrete, will be introduced. Next, the nano technology to achieve enhanced mechanical properties of cement-based materials through incorporation of nano particles will be presented.One example is to use nano particles to produce denser and more durable concrete to meet the construction needs under ocean environment. Also, by adding organic or inorganic nano particles into cement based materials, the flexural strength of the cement-based materials increasedsignificantly. For cement paste, bending strength is increased by three times without lowing the compressive strength. For concrete, 60% increase in flexural strength can be achieved.

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Bridge Structural Integrity Diagnostics Using Latest Passive Techniques

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Rekha H. Shertukde, MPA Chief Administrative Officer (CAO), DDI (www.diagnostic-devices.com)

Abstract

This paper describes an innovative and latest passive technique to evaluate structural integrity of concrete bridge structures. The application can be extended to any other building structure to assess the minute cracks that can burgeon into a catastrophic failure in high rise buildings. Such a preventive evaluation technique can avoid loss of life and property that can run into millions of dollars of capital assets.

The bridge infrastructure in the USA is old and needs clear rectification by rebuilding many critical bridges from coast to coast. Catastrophic failure in Minnesota in recent years over the past decade are glaring examples to ponder about to find the root cause of structural failure.

In our integrity diagnostics methodology, we use a patented and state-of-the art software/ hardware system which started as a desk top unit, followed by a lunchbox, industrial set up, followed by a handheld device as shown in the picture in the body of the paper in the following pages and also shown below for clarity. We now call it Fault Diagnostic Device for Concrete Bridges and Structures (FDD-CBS). This device is a simple modification of the patented device FDD-EPT (USPTO # 6,178,386; Shertukde, et.al.). We use supersonic sensors, which are piezo electric crystal sensors with a porcelain faced steel structure that can be clamped on to the steel structure or concrete structure using magnetic hold-downs or direct bolting of the sensor face plate on the concrete structure for a permanent installation respectively.

FDD-CBS

Keynote Forum

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Fire Performance of Steel Truss-Concrete Composite Bridge Girders

Gang Zhang*, Chenhao Tang, Chaojie Song, Xuyang Li
Chang'an University, China

Abstract

This report presents an approach for evaluating fire performance of steel truss-concrete composite bridge girders, and also provide strategies enhancing fire resistance of steel truss-concrete composite bridge girders. The model takes into consideration sensitive parameters namely; fire scenario, fire exposure position and length, load level and position, sectional type in steel truss and height-span ratio, that influence fire performance of steel truss-concrete composite bridge girders. A developed 3-D nonlinear finite element, using the computer program ANSYS, is applied to trace fire response of steel truss-concrete composite bridge girders. The finite element model is performed a validation through comparing predicted truss temperatures and structural deflections generated from a fire test on steel-concrete box bridge girder. The applicability of the built numerical model in practical application is illustrated dependent on numerical analysis of a composite truss bridge girder subjected to simultaneous structural loading and fire exposure. Results from the numerical study clearly show that fire severity, fire exposure position and length, load level and position, sectional type in steel truss and height-span ratio have significant influence on the fire resistance of composite truss bridge girders. Provision of inclined box shape truss can prevent local buckling and result in lower deflections; thus improving fire resistance. Further, large height-span ration incorporated into designed sectional shape can enhance fire resistance of composite truss bridge girders.

Keywords

Composite Truss Bridge Girders; Fire Performance; FEM, Fire Scenarios; Fire Resistance

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Smart drone SfM procedures aimed at the monitoring of Civil Infrastructures

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DIING Department of Enigineering, University of Palermo, Viale delle Scienze, Palermo, Italy

Abstract

Road Networks are key drivers for economic success in any city, region or country. However, globally today there are enormous challenges in trying to ensure the road networks are kept in good and acceptable states throughout their life. These challenges arise from continually decreasing budgets, which now will be further impacted by the current pandemic driven economic crises. The deficiencies often result in ineffective data collection and management practices. This research targets alleviating some of these difficulties whilst trying to help road managers deliver better pavement management strategies and systems. Specifically, the concepts of sustainable data collection and analyses are tackled. The study identifies low-cost but accurate strategies and techniques to collect road condition data mainly using simple and readily available devices such as smartphones and drones. Imagery is collected from smartphones and cameras, and the images are used in two important workflows. The first develops deep learning models capable of detecting where pavement distresses occur to carry out hotspot analyses on road networks whilst providing an idea of the severity of damages. The second uses images in a 3D modelling workflow to reconstruct and segment pavements to pinpoint and analyse the distresses producing metric assessments of damage levels at specific points within road networks. Several case studies are built using different equipment parameters and in different environmental conditions to validate the techniques and the models developed. In this presentation, I will show a case study of smart monitoring applied on pavement road to detect the distresses and verify the real state of life of the infrastructures. The methodology used is based on the photogrammetric technique that allows us to carry out a 3D model that has the follow features: low cost process, low time process, user friendly, repeatability. These features consent to make a planning with frequently acquisition to guarantee a reliability monitoring. It works with the comparison between the dense clouds of the 3D models acquired in different moment: the mean square distance between the dense clouds shows where there has been a new distress or an increasing of an old distress. The study identifies low-cost but accurate strategies and techniques to collect road condition data mainly using simple and readily available devices such as smartphones and drones.

The research has three key concept: the first one is the application of data analysis using limited data sets to understand historical and future road maintenance interventions; the second one is the application of image based 3D modelling and analysis of pavement distresses; the third one is the application of deep learning to detect and pinpoint pavement distresses.

Keywords

Monitoring; Sfm; Detection; Pavement Distress

Biography

Laura Inzerillo is Associate Professor at University of Palermo within the Department of Engineering. Graduated cum laude in Management Engineering at University of Palermo, 1995. Ph.D in Digital Survey and Representation of the landscape and Architecture at University of Palermo in 1999. She won a fellowship ata Columbia University from 1999 to 2000 with the confirmation of researcher at Columbia University from 2000 to 2003 at MUD. She won a post PhD fellowship at Univesrity of Palermo from 2000 to 2004 when she became researcher. Her fields of expertise are the digital survey, 3D representation, Descriptive Geometry, reverse Engineering, monitoring.

She is editorial member of several International Journals, reviewer member in other several International Journals, chief in editor of a special issue in MDPI Journal. She is actually authors of about 150 paper, 3 monographies, 2 chief in editor books and she won a best award paper. She has been involved in several international and national projects. Actually she is involved in SMARTI ETN

- Sustainable Multi-functional Automated Resilient Transport Infrastructures European Training Network HORIZON20-20; in REMED - Application de l'économie circulaire pour une construction durable en Méditerranée ENI CBC MED European Union.

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Structural Resilience and SHM: Post-Collapse Analysis, and Integrated Solutions for Damage Detection

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Abstract

Civil engineering constructions can sustain damage from a variety of degradations, such as long-term corrosion or fatigue, as well as short-time events like earthquakes. Damage diagnosis enables decision-makers to be informed about the best course of action to take in dangerous structural conditions. In this regard, structural resilience—the capacity of a system to lessen the likelihood of shock, to withstand shock if it occurs, and to recover swiftly from stress—can be improved via structural health monitoring. Starting with terminology from the literature, the first section of the present contribution focuses on discussing the relationship between structural health monitoring and structural resilience.
Besides, some recent examples of bridge collapses in Italy, in which a general lack of system resilience can be observed (Polcevera balanced system and the Caprigliola bridge), are reported and discussed with a perspective on bridge and transport network resilience. A post-collapse analysis for the Polcevera balanced system is also reported.

The key role of real-time monitoring solutions in preventing critical structural conditions is also discussed along with the useful adoption of basic engineering principles for estimation of remaining life of the infrastructures without an active instrumented structural health monitoring system. Finally, some research developments at the Politecnico di Torino - DISEG on the implementation of integrated SHM technologies on structural elements to detect and localize damages (fiber optic, digital image correlation and acoustic emissions) are presented.

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Geopolymer Materials for Durable Concrete Applications

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Abstract

Geopolymers are inorganic nanomaterials that provide promising environmental friendly alternative to cementitious binders and improved properties for special applications when used to construct and build our infrastructures. Well deigned geopolymers exhibit excellent resistance to acid attacks, outperforming conventional cement-based materials. This can be explained by the geopolymer macromolecular nanostructure that exhibits lower solubility than calcium-rich cementitious hydration products. Degradation of concrete structures by acidic solutions is of great interest in numerous applications and environments, such as sewer and agricultural structures, areas of acid mine drainage, cooling towers, and biogas or dairy plants.

Concrete structures exposed to acidic conditions should be designed according to (XA1) XA2 or XA3 exposure class, depending on the concentration of the aggressive species (including pH), typically requiring a surface protection method by usage of coating or lining. However, current widespread use of polymer coatings/linings demands a dramatic shift towards inorganic alternatives, mostly due to environmental issues of organic polymers, but also due to some durability issues, mostly related to relatively high permeation causing delamination and blistering. Geopolymers are identified as an emerging and a sustainable repair mortar alternative to cement-based and organic surface protection coatings. Although well-designed geopolymers indicate inferior acid and sulphate resistance, more research is needed for structural concrete applications due to lower chloride binding and alkali leaching (lower pH buffer) capacity which may pose threats for de-passivation of reinforcing steel.

This keynote presentation gives an overview of the fundamentals for the acid resistance of inorganic binders, comparing underlying chemical mechanisms between geopolymers, calcium aluminate, and Portland cements as well as hybrid (inorganic) binders. Moreover, it presents a new mathematical modelling approach to predict the durability of geopolymer materials, calibrated on experimental results. Most importantly, this synthesis enabled to further evaluate the diffusion-based models for alkali leaching from geopolymers on additional measurement results related to both sulfuric and acetic acid scenarios. Results are compared from a broader perspective to a parallel research that revealed geopolymers acid attack mechanisms when exposed to acetic and sulfuric acid in lab and biogenic field conditions. Under sulfuric acid case, precipitation of expansive sulphate salts further accelerates the damage process by cracking.

Existing experimental methods for leaching in pure water were adopted for more aggressive conditions in acidic solutions. Optimal values of critical test parameters, like sample geometry and liquid-to-solid ratio are discussed in terms of validity for mathematical modelling

assumptions. Tests under laboratory conditions combined analyses of both liquid and solid samples. In the exposure solutions, the eluted elements were measured over time by inductively coupled plasma (ICP) mass spectroscopy (MS) or optical emission spectroscopy (OES) and from elemental distributions at different depths determined on cross-sections of solid samples using scanning electron microscopy with energy dispersive spectroscopy (SEM-EDS).

Keywords
Geopolymers; Concrete Durability; Acid attack; Mathematical modelling.

Biography
Neven Ukrainczyk, as a Team Lead at Institute of Construction and Building Materials of TU Darmstadt, enjoys combining computational and experimental approaches for engineering chemical and physical properties of building materials. He leads several national research and industry projects, co-leads EU projects, and has finished more than ten research projects at TU Darmstadt, TU Delft (Marie Curie excellent science grant), TU Graz (as visiting prof.), Uni Zagreb and UFRJ (Brazil). As a RILEM member he contributes to four past and four running Technical Committees (leads TC-EBD WG4 on Reactive Transport). Current teaching activities include lecturing RILEM Computational Methods (since 2016) and Building Chemistry courses at TU Darmstadt.
Current research is focused on Durability of Geopolymer binders, as part of his habilitation thesis. Previously, he was awarded a Marie-Curie post-doc project on Morphological nature of Effective Diffusion in cementitious materials (2011-2013 at TU Delft). His PhD thesis was on Modelling Calcium Aluminate Cement Hydration (Croatia 2009), and MSc thesis on ANN fuzzy-classification model for Durability of Concrete Structures (2004).

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Groundwater Control Impacts on Design and Construction of Deep Excavation and Support System

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Abstract
This paper will briefly review the development of design methodology and code of practice of retention system for deep excavations, with an emphasis on the consequences of failures. The groundwater control and its impacts on the design and construction for the deep excavation and support system will be further discussed. Guidance of selecting different types of retaining system to suit the geological conditions will be summarised from a practical engineering perspective. Issues related to groundwater such as regional groundwater flow and water main breakage impacts will be examined by some of the real project examples. Some worked project cases will be given to structures that were either designed as a drained structure or tanked structure based on the required groundwater inflow limits. Several ground support strategies against groundwater or uplift together with construction methodology will be explained using the actual projects, either for the temporary conditions or permanent conditions. Some of the typical control measures and details against groundwater inflow for underground structures such as railway stations will be provided. Some useful design considerations and lessons learned will be summarised in the conclusion.

Keywords
Groundwater, Retention System, Deep Excavation, Practical Design Approach

Biography
Dr Qijing Yang is currently a Senior Technical Director & Regional Technical Director of Arcadis Australia Pacific based in Sydney, Australia. Dr Yang is also an adjunct professor at East China Jiao Tong University. His consulting experiences are primarily in infrastructure development specialized in geotechnical engineering and tunnelling within Australia and overseas.

Dr Yang joined the University of New South Wales, Sydney, Australia as a visiting research fellow in 1991 after obtaining his PhD in Geotechnical Engineering from Wuhan University in 1990. He started his consulting career with Coffey Partners as a Geotechnical Engineer in Melbourne in 1993 and then in Sydney. He then worked at Maunsell (now AECOM) as a Senior Geotechnical Engineer in Sydney in 1996. In 2001 he joined Hyder Consulting as a Principal Engineer in Sydney and was promoted to Technical Director in 2006 and Regional Technical Director in 2011.

Dr. Yang is a Fellow, Engineering Executive, Charter Professional Engineer of Institution of Engineers, Australia. He is a member of Australian Geomechanics Society and a Registered Professional Engineers of Queensland. He is also a member of International Society of Soil Mechanics and Geotechnical Engineering, and International Society of Engineering Geology and Environment. He was a committee member of Australian Geomechanics Society and has

published more than 70 papers in journals and conferences while practicing in geotechnical engineering and tunnelling. The projects he involved have won many prestigious awards within Australia and overseas.

Artificial Intelligence and Machine Learning for Smart Transportation Infrastructure

Sanjay Ranka*
University of Florida, USA

Abstract

Mitigating traffic congestion and improving safety are the cornerstones of transportation within smart cities. Current practices collect and analyze data from sensors and video processing and then process it offline. Hence, they are limited in proactively reducing traffic fatalities and preventable delays at intersections. We are developing edge based real-time artificial intelligence algorithms and software to analyze video feeds from cameras and fuse them with ground sensor data to develop deep learning based digital twins that mimic traffic behavior both at an intersection and at the city level. We are also using the resultant output to develop technologies that will quantitatively measure and rank intersections by safety, to transmit information about unsafe behavior to connected vehicles and pedestrians in real-time to prevent accidents, and to optimize signal timing to reduce congestion.

Each of these advances are presently being field tested at intersections in the City of Gainesville and in Seminole County. The overall effort is geared toward developing transportation solutions for leading edge 21st century smart cities.

Biography

Sanjay Ranka is a Distinguished Professor in the Department of Computer Information Science and Engineering at University of Florida. From 1999-2002, as the Chief Technology Officer at Paramark (Sunnyvale, CA), he developed a real-time optimization service called PILOT for marketing campaigns. PILOT served more than 10 million optimized decisions a day in 2002 with a 99.99% uptime. Paramark was recognized by VentureWire/Technologic Partners as a Top 100 Internet technology company in 2001 and 2002 and was acquired in 2002. Sanjay has also held positions as a tenured faculty member at Syracuse University, academic visitor at IBM and summer researcher at Hitachi America Limited.

Research in high performance computing and bigdata science is an important avenue for novel discoveries in large-scale applications. The focus of his current research is the development of efficient computational methods and data analysis techniques to model scientific phenomenon, and practical applications of focus are improvements to the quality of healthcare and the reduction of traffic accidents. A core aspiration of his research is to develop novel algorithms and software that make an impact on the application domain, exploiting the interdependence

between theory and practice of computer science

He has coauthored one book, four monographs, 300+ journal and refereed conference articles. His recent coauthored work has received a best student paper runner-up award at IGARSS 2015, best paper award at BICOB 2014, best student paper award at ACM-BCB 2010, best paper runner-up award at KDD-2009, a nomination for the Robbins Prize for the best paper in the Journal of Physics in Medicine and Biology in 2008, and a best paper award at ICN 2007.

He is a fellow of the IEEE, AAAS and AAIA (Asia-Pacific Artificial Intelligence Association) and a past member of IFIP Committee on System Modeling and Optimization. He won the 2020 Research Impact Award from IEEE Technical Committee on Cloud Computing. He is an associate editor-in-chief of the Journal of Parallel and Distributed Computing and an associate editor for ACM Computing Surveys, IEEE/ACM Transactions on Computational Biology and Bioinformatics, Sustainable Computing: Systems and Informatics, Knowledge and Information Systems, and International Journal of Computing. Additionally, he is a book series editor for CRC Press for Bigdata. In the past, he has been an associate editor for IEEE Transactions on Parallel and Distributed Systems and IEEE Transactions on Computers.

He was a general co-chair for ICDM in 2009, International Green Computing Conference in 2010 and International Green Computing Conference in 2011, a general chair for ACM Conference on Bioinformatics and Computational Biology in 2012, and a program chair for 2013 International Parallel and Distributed Processing Symposium and 2015 High Performance Computing Conference. He was a co-general chair for DataCom 2017 and co-program chair for ICMLDS 2017 and 2018.

Application of Unmanned Aerial Vehicles (UAVs) for Structural Health Monitoring of Infrastructure Assets

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Abstract
Advancements in the field of unmanned vehicles, complemented by the development of portable sensors, have paved the way for the application of unmanned aerial platforms for collecting infrastructure performance data. Unmanned aerial vehicles have been put into use for various civil engineering applications like monitoring construction activities, performing traffic aerial surveys, monitoring infrastructure including pavements, bridges, rail lines, dams, and construction material stockpiles. Some of the case studies demonstrating the feasibility of using unmanned aerial vehicles close-range photogrammetry (UAV-CRP) technology for health monitoring of transportation infrastructure assets like pavements, bridges, railways, and dams will be covered in the presentation. In addition, some of the important guidelines of the UAV flight operation manual will also be discussed

Invited Forum

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From Digital Survey to HBIM Model for The Valorisation and Management of Architectural Heritage

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Abstract
The research analyzes the different stages of development of scan-to-HBIM models aimed at representing the built architectural heritage.
Scan-to-HBIM modeling involves using 3D digital survey techniques to produce point clouds as a geometric database to facilitate parametric modeling.
This generative process is encouraged by instrumental technological development.
The digitization of management planning requires tools to design and update data acquisition and management protocols. With this in mind, producing portable 3D mapping solutions designed to benefit scan-to-BIM processes has increased in recent years, reducing workflow time. In this sense, parametric modeling software applications are increasingly open to integrating 3D point cloud data within the modeling space.
This research proposes a critical analysis of digital acquisition tools and practices by investigating methods of mobile acquisition, processing, and point cloud data optimization aimed at parametric generation. The scan-to-HBIM process was tested, by the DAda-LAB Research Laboratory of the University of Pavia, on different architectural complexes in Europe.
The first phase of the research involved the application of a digital survey method based on integrating different techniques (laser scanning and photogrammetry) to optimize the point cloud data acquisition and processing phase.
The second phase analyzing how the acquired data could be helpful in the H-BIM model development of the building. The modeling workflow used is a collaborative one. For each model, a classification of the elements was realized through the design of a shared abacus, considering the definition of different LOD (Level of detail) and the typological connotation of the individual case studies. The elements of each model are classified and coded through the design of a shared abacus, which considers the definition of different LODs and the typological connotation of the individual case studies.
The research aims to optimize the scan-to-HBIM process, validate the acquisition processes, and evaluate the potential, limitations, and planimetric and altimetric accuracy of the mobile data. The H-BIM model is conceived for each case study and designed in the long term as a single monitoring tool for planned maintenance and extraordinary interventions. The H-BIM models produced by this research are built based on the metric data of the digital survey to

investigate the different possibilities and limits of using these models, from asset management to digitized spaces.

Keywords
Scan-to-HBIM; 3D modeling; mobile laser scanner; HBIM.

Biography
Research fellow at the Department of Civil Engineering and Architecture of the University of Pavia, PhD in Architecture (XXXIII cycle), specialization in Survey and Representation of Architecture and the Environment. Since 2015 she has been actively collaborating with the DAda-LAB - Drawing Architecture DocumentAtion Laboratory in particular on issues related to the management of databases dealing with parametric modeling systems and detection systems using mobile technology. From 2017, she is the technical coordinator of a research mission on the documentation of the monumental complex of theAlhambra functional to the development of HBIM systems in collaboration with the University of Granada. From 2018, she participates as ESR in the research project PROMETHEUS H2020 - Documentation ofreligious complexes Upper Kama, EU project Horizon2020 Marie Skłodowska-Curie Actions (MSCA) Research and Innovation Staff Exchange (RISE) H2020-MSCA-RISE-2018, Project Acronym:PROMETHEUS – Project Number: 821870 for the definition of Documentation Protocols based onInformation Models and the development of Digital Libraries on European Cultural Heritage Routes, inparticular dealing with systems and models parameters for the management and enhancement of the territory. From 2020 she is coordinator of the scientific research project on the documentation of the Verona wall systems in an agreement between DICAr and the Municipality of Verona and the UNESCO Office. She is coordinator of several scientific activities by agreements of scientific collaboration and technology transfer between the DICAr of the University of Pavia and enterprises. The activities related to technology transfer between the University and the company concern the testing of methodologies and tools, produced by thecompany, for digital surveying and the definition of a methodological protocol for data acquisition, optimization and management. She is part of editorial international scientific journals committees.

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A Two-way ANOVA based Evaluation Method for Repeatability, Reproducibility and Capacity of QC Testing

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Abstract

To quantify errors arising from a single operator or multiple laboratories, most testing standards uses a one-way analysis of variance (ANOVA) based method, which utilizes a simple standard deviation across all measurements. However, this method does not allow users to quantify the sources of error and capacity (i.e., the precision to tolerance ratio). In this study, an innovative two-way ANOVA-based analysis method is proposed to quantify the relative contributions of different sources of error and determine whether a measurement can be used to check conformance of a measured characteristic to engineering specifications. In this study, the standardized Atterberg limits tests, fall-cone device Atterberg limits tests, and bar linear shrinkage tests for determining the soil plasticity were selected for evaluation and demonstration. Comparisons between results of the various testing methods are presented, and the error sources contributing to the overall variations between tests are discussed. Based on the findings of this study, the authors propose use of the two-way ANOVA-based R&R analysis to quantify the sources of measurement error and capacity and recommend using fall cone test and ASTM standardized roller plastic limit test for determining liquid and plastic limits of soils, respectively.

Keywords

Repeatability; Reproducibility; Source of Error; Measurement Capacity

Biography

Dr. Cheng Li is an associate professor in the School of Highway at Chang'an University. He obtained his B.S., M.S., and Ph.D. degrees from Iowa State University USA. His research focuses on developing performance-based quality control (QC) testing methods for geotechnical and pavement engineering. He is currently serving as the associate director of the Key Laboratory for Special Area Highway Engineering of Ministry of Education of China and the deputy director of the Center for International Education of the School of Highway at Chang'an University. He is also a member of the Technical Committee of Road Materials and Subgrade committee of the World Convention of Transport (WTC), a young academic editor of the Journal of Traffic and Transportation Engineering. At present, he serves as PI or Co-PI on over 5 research projects funded by the National Natural Science Foundation of China and the National Key R&D Program of China. Base on his research findings, he published over 20 SCI papers (1 ESI highly cited paper and awarded the 2016 Iowa State University Graduate Research Excellence Award.

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Recommendations for Building Architecture to Ensuring the Smooth Implementation of ICT, an Essential Element of the Hospital Infrastructure

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Abstract

ICT has become an essential part of the infrastructure of modern hospitals. Unfortunately, ICT-related construction and the installation of ICT equipment often takes place during the final stages of hospital construction. This is partly due to the fact that ICT-related items are treated as “equipment”, not as part of the "facility". An additional factor that can be problematic is that as the construction progresses, design changes may occur. The above can result in a number of problems related to equipment and its operation. For example, architects may not include sufficient space or power supply for communication cables and antennas used for wireless communication that are placed in ceilings or shafts. This can cause problems with radio communications when signals do not reach the required areas.

In addition, if communication cables (other than optical cables) are placed in close proximity to high-current wiring, noise may be superimposed on the system.

In this presentation, I will show problems related to the ICT infrastructure of hospitals and possible solutions, with introducing Japanese two guidelines for wireless communication systems in hospitals.

Keywords

Hospital Building; ICT; Cables; Wireless Communication.

Biography

Eisuke Hanada was born in Tokyo, Japan, in 1963. He received his B.Eng. and M. Eng. degrees from Kyushu University, Fukuoka, Japan, in 1985 and 1987, respectively. He received his D.Eng. degree from Saga University, Saga, Japan, in 2001. Prof. Hanada has been working in the Department of Information Science, Saga University Faculty of Science and Engineering since Oct. 2014. He previously worked at the Nagasaki University Information Science Centre (1992-1996), at the Department of Medical Information Science, Kyushu University Graduate School of Medical Science (1996-2002), and at the Division of Medical Informatics, Shimane University Hospital as vice director (2002-2014). His research involves the wired/radio communication environment, EMC of medical devices, hospital information systems, ICT/IoT systems in clinical scene, AI use for medical staffs, and telemedicine. He had involved in re-development of both Kyushu University Hospital and Shimane University Hospital. Prof. Hanada is a member of the Japanese Society of Medical Informatics, the Information Processing Society of Japan, the Japanese Society of Medical and Biomedical Engineering, the Healthcare Engineering Association of Japan (a board member), and the Acoustical Society of Japan.

Ancient Stone Masonry Constructions in Portugal Constructive Solutions and Main Structural Rehabilitation Techniques

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Abstract

In Portugal, masonry constructions, in general, still represent about half of the existing constructions. In this context, the presentation will focus on the experimental work that the author has been developing at FCT NOVA, namely the characterization of ancient stone masonry walls and applicable strengthening solutions, using several specimens built for this purpose.

Particular emphasis will be given to strengthening solutions based on steel transverse confinement elements, reinforced mortar and reinforced micro-concrete. The behavior of the strengthened walls will be compared with the behavior of the unreinforced walls (URM).

The evolution of the carbonation depth of traditional stone masonry walls will also be addressed, regarding its implications on the strength over time.

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Seismic Response and Vulnerability of Metro Tunnels in Shallow Soil Deposits

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Abstract

The seismic response of metro tunnels is keyfor the sustainability of transportation networks. Although ground tunnels may suffer less damage than conventional aboveground structures, recent experimental and post-earthquakes reconnaissance studies have shown that extensive damage under typical design earthquake scenarios may be possible. Evaluating the seismic response of metro tunnels on a scenario-based approach is difficult without a well-calibrated numerical model suitable for soil-structure interaction problems. In addition, published fragility functions for tunnels are very scarce; most of them developed for tunnels in regions affected by shallow crustal earthquakes, and derived from numerical analyses that rely on a small number of ground motions recordings. Traditional approaches may provide reasonable estimates of the median tunnel response; however, they are not well suited to characterize the uncertainty in the response, which is vital for risk-based assessments. To address these limitations, the current study uses a performance-based approach to estimate mean rates of exceedance of critical engineering demand parameters (EDPs) used in tunnel design (e.g., internal forces on the lining, diametral strains, ground deformation parameters, among others). Additionally, seismic demand hazard curves are developed taking into account the earthquake source mechanism and a large number of records to capture the mean or expected EDP values as well as the quantification of uncertainties. The fragility functions are derived from finite element model (2D) and dynamic analyses of a dual-track circular tunnel on medium dense soil; the tunnel has a depth of 12 m, 6 m in diameter, and a 30 cm thick sprayed concrete lining with steel rebar, a typical design for interstation tunnels used in dense urban areas. The numerical model implemented in OpenSees uses linear elastic elements for the lining and the non-linear pressure dependent constitutive model PDMY02 to model the soil response. The model parameters were validated with dynamic centrifuge test results of a circular tunnel on Leighton Buzzard Sand subjected to harmonic base excitation, laboratory tests for the sand, and results derived from the theory of elasticity. The numerical model captured the stiffness, strength, and energy dissipation properties of the materials, as well as the dynamic response of the soil deposit and the tunnel. The study provides mean annual rates of exceedance of the most common design parameters used in metro tunnels.

Keywords
Tunnels; Earthquake; Performance-Based Analysis; Fragility

Biography
Dr. Candia (Ph.D UC Berkeley 2013) is a structural and geotechnical engineer and currently Associate Professor at the Faculty of Civil Engineering of Universidad del Desarrollo-Chile, and Associate Researcher at CIGIDEN, a multidisciplinary center for research in natural disaster management. Dr. Candia has published over 25 research articles in the most prestigious journals in topics that range from seismic vulnerability and risk of complex systems, to physics based models for characterizing the seismic response of structures and geotechnical systems, the quantification of seismic hazards and software development. As member of the GEER Association (GeoEngineering Extreme Event Reconnaissance), Dr. Candia has participated in the reconnaissance efforts of several large earthquakes (Chile 2010, 2014, 2015; Mexico 2017; Peru 2019).

Centrifugally sprayed ECC for pipeline retrofitting

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Abstract

Current trenchless rehabilitation techniques for deteriorated concrete pipelines have limitations in field operation, pipeline geometry and size, durability, and structural retrofit. In this research, an innovative technology utilizing centrifugally sprayed ECC (CS ECC) to retrofit cracked concrete pipes is established. Rheology is engineered by hydroxypropyl methylcellulose for viscosity enhancement, citric acid for rheology evolution retardation, and hybrid synthetic fibers for flowability control. CS ECC is demonstrated capable of building up to 50 mm thickness on both vertical and horizontal concrete pipes, with reachable diameters over 300–900 mm. A 25 mm CS ECC (5.7 MPa-tensile strength and 5.3%-ductility) lining enhances the cracked concrete pipe by 2.2 times in load capacity and by 1.5 times in deformation capacity. Combining the advantages of mechanical and leak-proof performance, low cost, fast construction, self-healing ability, and expansive coupling with host pipe, the developed CS ECC holds promises in rehabilitating concrete pipelines, tunnels, and culverts.

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Evaluation of Pavement Roughness Using Smartphones Based on Full-Vehicle Models

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Abstract
Considering that the smartphone with built-in sensors transformed the way people's living and working styles, in this study, a computational model and theoretical algorithm utilizing smartphone were proposed to determine the International Roughness Index (IRI) based on vehicle suspension parameters and whole vehicle model. First, the driving data acquisition APP was developed using JAVA 8 as the programming language and Android Studio 3.4. Then, the identification on the suspension parameters of test vehicle was implemented by complex mode formulations and drop test. Subsequently, the algorithm about theoretical relationships among vehicle operating data, longitudinal elevation data (LED) and IRI were derived based on the whole vehicle model (WVM). Finally, an experimental verification was performed on bituminous pavement with known roughness index. The results demonstrated that the maximum relative error between the determined value and standard value was less than 11%. Overall, due to the consideration of vehicle dynamic characteristics, the proposed theoretical method could improve the measurement accuracy and enable various vehicles to be used for road roughness evaluation.

Keywords
Pavement roughness; Smartphone; Full-Vehicle Models; International Roughness Index.

Biography
Hongliang Zhang, male, born on Jan. 5 1974, PhD in Highway Engineering, professor in Chang'an University in China. The research area is mainly pavement material and structure, especially the ecological and environmentally friendly asphalt pavement, intelligent pavement, continuously reinforced concrete pavement and the development of new pavement materials. One book entitled by Continuously Reinforced Concrete Pavement and more than 100 articles in which more than 20 articles are cited by SCI are published, and 14 invention patents of China are authorized.
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Digital tools for e-conservation of Historical Masonry Bridges: from integrated survey methodologies to HBrIM passing for Virtual Reality

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Abstract

The large spread of digital technologies, software and tools created to support the construction industry today makes it possible to intervene with appropriate decision-making processes during the whole life cycle of buildings. In particular, the Building Information Modelling (BIM) has assumed a central role for architectural and infrastructural artefacts in the phases ranging from design to site management and maintenance planning. On the other hand, for the historical built and infrastructural heritage, some questions are still open on their parametric representation and in order to realise models from their semantic decomposition. Specific applications of the BIM method to road and rail infrastructures have been consolidated for new constructions, through the many Bridge Information Modelling (BrIM), which confirm how the process is facilitated in the initial feasibility assessment and the subsequent design and construction, by the analysis and control of times and costs. For historical infrastructures, which in terms of material characteristics and cultural aspects present problems similar to those found in parametric modelling of architectural and archaeological heritage, instead, these models are declined towards Historical Bridge Information Modelling (HBrIM). The digital representation of infrastructures then becomes essential when the assets arise in territories subject to multiple risk factors that could lead to their loss, as has been demonstrated by the catastrophic events that have affected the panorama of existing bridges in the national and international territory. The recent collapses and damage have brought attention back to the maintenance and durability of these artefacts, directing many of the countries involved towards the adaptation and definition of tools and regulatory frameworks aimed to improving their management, state of health, safety assessment and defining intervention priorities to be implemented in order to reduce the risks associated with their damage and loss. Greater attention in the analysis and digital representation field require the assets still in use, which are not only functional infrastructures for roads and connections, but are part of our built cultural heritage whose preservation must also be ensured also for intangible aspects. To guarantee this process, the orientation towards experimentation by fully digital techniques of representation and data management is also motivated by the massive use of Information and Communications Technology (ICT) applied to cultural heritage, which has favoured the definition of a new paradigm, defined as e-conservation. This new paradigm, on the one hand, to ensure the digital preservation of historical memory and the management of data resulting from knowledge analyses, and on the other hand, to provide digital tools oriented to favour

the analysis and definition of effective practices for the physical preservation of historical infrastructures. Within this framework, we are experimenting with operational methods aimed at defining complex information systems capable of combining traditional approaches used in the knowledge and data acquisition phases with innovative ones aimed at their digitisation. The use of virtual environments, suitable of linking different formats and multi-data, such as those resulting from the structural monitoring of artefacts, favours the development of tools to be trained by administrators in line with the e-conservation paradigm.

Keywords
Historical Masonry Bridges; E-Conservation, HBrIM; Integrated Survey.

Towards Condition Based Maintenance

Jacob Bortman*
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Abstract

As of today there is still a gap before CBM can fully implemented. The Ben Gurion University (BGU) Predictive Health Monitoring (PHM) laboratory main research subjects are related to the developments of new efficient algorithms for diagnostics and prognostics of mechanical systems, such as, bearings, gears, shafts, universal joints, and hydrodynamic bearings. Each study process is based on physical models (kinematic and dynamic) validated by experiments with seeded faults. The methodology is based on understanding the physics of the machine components and their expression in the vibration signal in the presence of a fault.

The presentation gives some examples of the type of research we do in order to achieve the CBM. It includes a short introduction of new models and tools used for monitoring bearings and gears, implementation of Fiber optic sensors (FBGs), damage mechanism simulating the initiation and propagation phases of spalls (collaboration with AFRL) and hybrid AI algorithms for tracking damage size in bearings.

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Development and Behavior of Novel FRP-UHPC Tubular Members

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Abstract

Ultra-high performance concrete (UHPC) have obtained increasing attention in research and industry communities. The unique merits of UHPC include extraordinary compressive strength and excellent corrosion resistance. However, UHPC under tension may exhibit a post-peak strain softening behavior. Although increasing fiber dosage could mitigate the strain softening behavior, using excessive fibers in UHPC for enhanced tensile properties may not be a good idea. Particularly, the issue of steel fiber corrosion is unavoidable if steel fibers are employed in UHPC.

Recently, fiber-reinforced polymer (FRP) grid or fiber textile has been proposed to be internal reinforcement for UHPC to solve the above issues. Our studies have also indicated that FRP grids have good bonding with the cementitious matrix with short fibers (Fig. 1). FRP grid also has an excellent tensile strength and satisfactory ultimate tensile strain owning to continuous fibers in FRP composites, making FRP-reinforced UHPC composite plates doomed to have excellent tensile properties. Also, FRP reinforcement could not only decrease the fiber dosage and cost of the UHPC, but also alleviate possible corrosion problem of the steel fibers in UHPC. If non-metallic fibers (e.g., polyethylene (PE) fibers) are used in FRP grid-reinforced UHPC composites, problems associated with corrosion are expected to be avoidable.

In this study, a series of novel forms of tubular members made of FRP grid-reinforced ultra- UHPC (referred to as “FRP-UHPC tubular members”) are developed. FRP-UHPC tubular members have excellent mechanical properties, and their excellent performances are demonstrated through three preliminary studies: i) behavior of FRP-UHPC plates and tubular beams (Figs. 2-3); ii) behavior of FRP-UHPC tubular columns under axial compression (Fig. 4); and iii) behavior of FRP-UHPC plates with a novel grouting sleeve connection system under bending (Fig. 5). The experimental programs and results are briefed in the abstract. The proposed FRP-UHPC tubular members are attractive in various structural applications such as pipelines, bridge box girders, permanent formwork of beams/columns, especially in marine environments (e.g. floating structures).

Keywords

Ultra-High-Performance Concrete (UHPC); Fiber-Reinforced Polymer (FRP) Grid; Tubular

Structural Members; FRP Bar

Fig. 1.

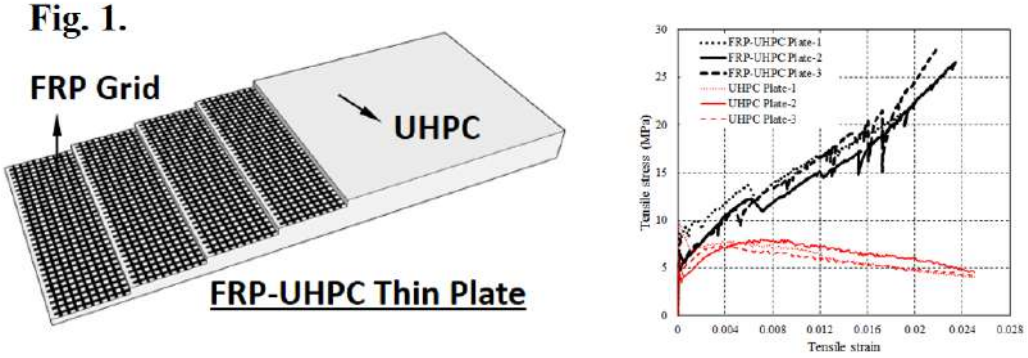


Fig. 2.

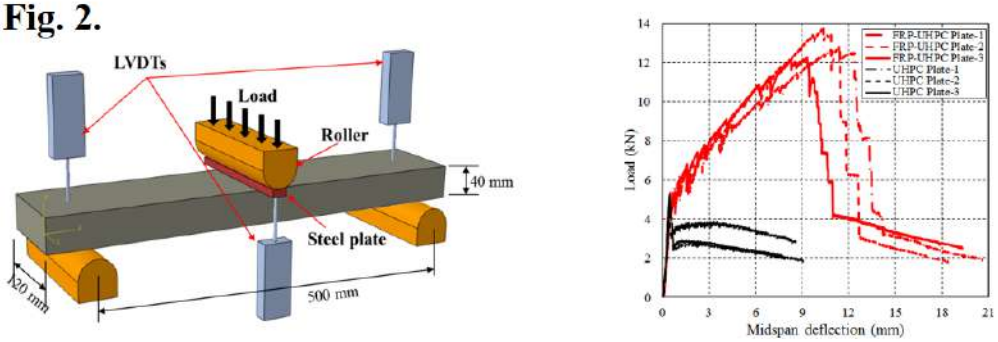


Fig. 3.

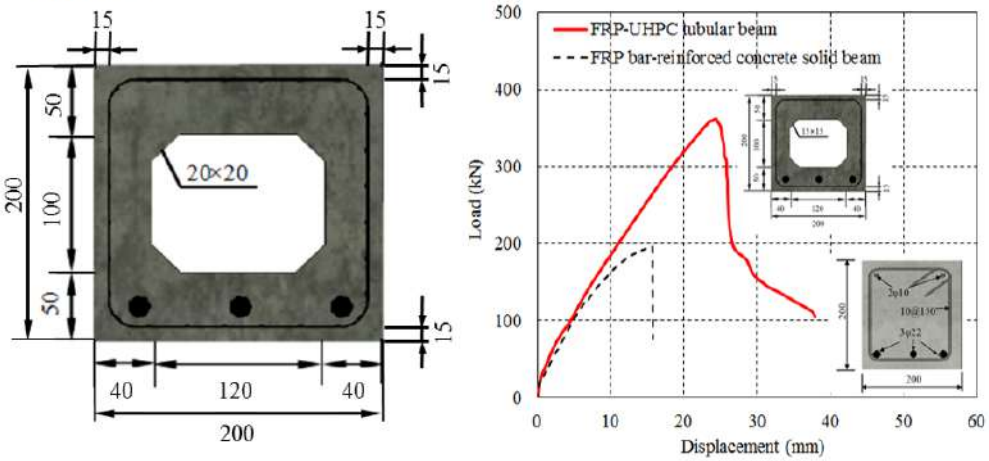
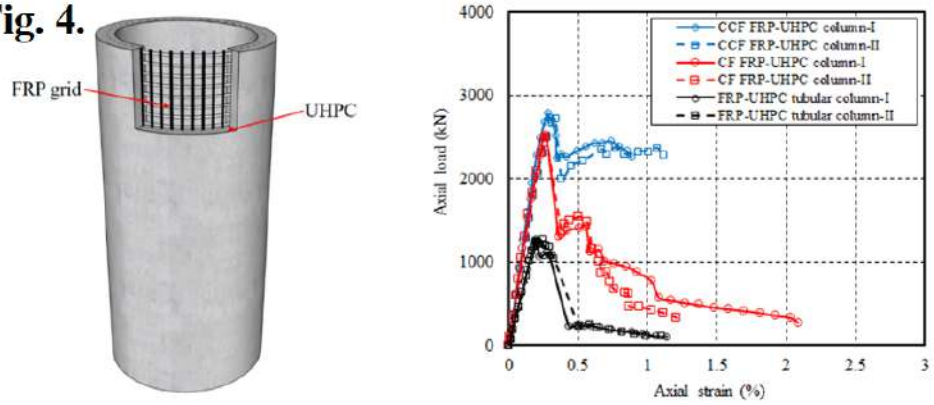


Fig. 4.



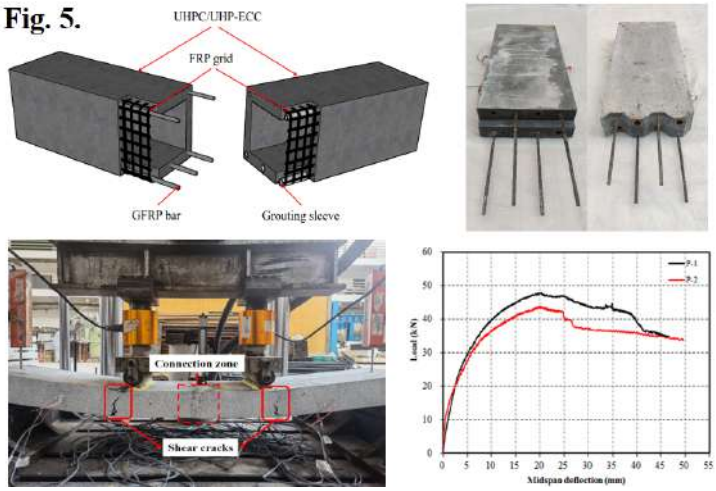


Fig. 1 Tensile behavior of FRP-UHPC plates; Fig. 2 Flexural behavior of FRP-UHPC plates; Fig. 3 Behavior of FRP-UHPC tubular beams under shear; Fig. 4 Axial compressive behavior of FRP-UHPC tubular columns and concrete-filled FRP-UHPC tubular columns; Fig. 5 Connection system for FRP-UHPC tubular members.

Acknowledgment

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Innovative Contracting Method: Performance-Based Contracting

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Abstract

Transportation agencies commonly outsource their work to private contractors for various reasons. Two outsourcing methods are standard for agencies today – Method-based Contracting (MBC) and Performance-based Contracting (PBC). The PBC is a comparatively newer contracting method for most transportation agencies in the United States, although it was first used in Canada in 1988. The PBC method differs from the MBC method based on specification because this approach offers incentives and disincentives based on how the contractor performed the job – higher pay for higher quality and lower pay for lower quality. This provision also fosters innovation. Because of this uniqueness with this approach, this approach is also referred to as an innovative contracting method. Today, transportation agencies have implemented the PBC approach around the world; at least 39 countries use it globally, and at least half of states use this strategy in the United States. The key benefits of using this innovative strategy are saving costs, transferring agency risks to the PBC contractor, improving service quality of the product, etc. Existing literatures show that the PBC approach has been used for roadway and bridge construction and maintenance, highway safety rest areas, etc. Transportation agencies have used two forms of PBCs – pure PBC and hybrid PBC.

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New developments of FRP-Strengthened Steel Structures

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Abstract

Fiber reinforced polymers (FRPs), especially carbon fiber reinforced polymers (CFRPs), have a high strength, light weight, good fatigue and corrosion resistance. Applying FRPs in strengthening/reinforcing steels provides a number of meaningful advantages. This paper presents a novel method, which is using prestressed CFRP strips to reinforce steel columns and beams. It can be applied in new structures or to strengthen existing structures, and is easy to construct. The buckling behavior of reinforced steel columns is studied with axial and eccentric compression tests. The obvious reinforcing efficiency is achieved; the buckling capacity of reinforced specimens can be increased by 19%–150%. In addition, the flexural behavior of the reinforced steel purlins was also studied. The flexural capacity and stiffness were improved by 14% to 18% and 28% to 31% in tests, respectively. The whole loading procedure is analyzed in detail to explain the mechanism of CFRP reinforcing. Corresponding theoretical studies were also conducted. This study provides new ideas and useful references for reinforcing steel structures with FRPs.

Keywords

Fiber Reinforced Polymer; Steel Structure; Strengthening; Prestressed

Biography

Dr. Hu works on a wide range of inter-disciplinary engineering innovation, especially on structural technologies with emerging materials, systems and construction for civil engineering. Her research interests include high performance fiber-reinforce polymer (FRP) composite structures and advanced construction technology. She has authored/co-authored over 20 international journal papers leading to over 320 citations and H-index 11 according to Google Scholar Citations. She is the inventor of 9 patents on novel structural technologies. She is a frequent speaker in international/national conferences and seminars, and she gave 6 lectures in international top conferences of her research field. Dr. Hu's research contributions have been recognized by a number of honors, including Sailing Young Scientific Talent of Shanghai.

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A semi-analytical 1D model and its application in OpenFAST for offshore wind turbines

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Abstract
A semi-analytical 1D model with the eight types of soil reactions is derived from the fishbone frame model, in which the effects of the pile diameter and aspect ratio are captured by the lateral and rotational soil reactions. In the proposed model, a new p-y model is proposed to match the desired modulus reduction curve by identifying three parameters in a hyperbolic function and a linear function using a genetic algorithm (GA), and the desired damping curve by applying the Ishihara-Yoshida rule that controls the unloading-reloading curves iteratively through the three parameters. A FounDyn module is created in OpenFAST to consider foundation dynamics, which is an appealing supplement to the current version of OpenFAST. The FounDyn module receives the motions from the SubDyn module and sends the forces back to the SubDyn module. In FounDyn, the soil-monopile interaction is captured using the semi-analytical 1D model. A series of emergency shutdown analyses of the NREL 5MW wind turbine are performed using OpenFAST plus FounDyn. The results show that the misalignment of wind and wave affects the tower bending moments significantly.

Keywords
Offshore wind turbine; Monopile; New p-y model; FounDyn.

Biography
Dr. Wang obtained his master's degree in civil engineering from Tongji University in China in 2016. Later, he obtained his doctoral degree in civil engineering from University of Tokyo in Japan in 2019. He was a project assistant professor in University of Tokyo for Laboratory of Joint Program for next generation of energy infrastructure funded by J-POWER, Shimizu Corporation, Toshiba Energy Systems & Solutions Corporation, MHI Vestas Offshore Wind Japan, ClassNK. Currently, he is a Young Professor in Zhejiang University. He has interests in Wind Turbine Engineering, Marine Structural Engineering and Marine Geotechnical Engineering, acting on the following topics: soil-structure interaction, optimal design of offshore wind turbines and smart monitoring and maintenance of offshore wind farms.

Stability Analysis in Unsaturated Soils

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Abstract

Since its inception, the geo-mechanical stability problems are carried out by considering the soil to be in either of the extremely saturation stages, namely, completelydry state or completely saturated state. However, most of the habitable areas, where construction works are exercised, lie in arid and semi-arid zones; hence, the stability analyses must be executed by duly employing the unsaturated soil mechanics. The present talk addresses how the varying saturation state of the soil above the groundwater table is incorporated into the stability analysis. Unlike the sole stress state parameter (i.e. effective stress) in saturated soil mechanics, two stress state variables, net normal stress and matric suction, govern the soil's (unsaturated) overall stability. The usage of the most fundamental predictive and versatile tool, namely, soil water characteristics curve (SWCC) is thoroughly discussed in this talk. Two geo-mechanical stability problems arechosen for theillustration – evaluating soil slopestability and computing lateral earth pressures of vertical retaining walls. To understand the combined effect of hydromechanical parameters, groundwater table fluctuations, and climate changes, the stability numbers and the earth pressures are presented by performing a rigorous parametric study.

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Impact of Climate Change in Coastal Region of Bangladesh: Vulnerability, Adaptability and Resilience

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Abstract

Bangladesh is one of the most impacted countries by climate change. The sea-level rise leads to increasing incidences of tropical cyclones, storm surges, floods, nor' westers, salinity effect, droughts, and tornadoes. Climate change and sea-level rise have devastated coastal ecosystems and the local economy, causing massive panic throughout the nation. The coastal region of Bangladesh is about 20% of total land area and over 30% of the cultivable lands of the country. It consist of world's largest mangrove areas of the Sundarbans, highly diverse ecosystems, beaches, coral reefs, dunes and wetlands. The dynamic natural environments of this mangrove areas provides a range of goods and services to the peoples of Bangladesh. It is well documented that Bangladesh, a deltaic coastal country is one of the most devastating and vulnerable countries to climate change in the world. Climate change and sea-level rise have devastated coastal ecosystems and the local economy, causing massive panic throughout the nation. Climate related change in coastal zones embodies potential additional stress on systems that are already under intense and growing pressure. The country has been facing several climate change effects such as increasing cyclones, flood frequency probabilities, erosion, inundation, rising water tables, salt water intrusion and biological effects. Coastal environments particularly at risk include mangroves, tidal deltas and low-lying coastal plains, sandy beaches, coastal wetlands, estuaries and coral reefs.Studies show that global warming and climate change create a significant threat to Bangladesh. It is projected that by 2050 part of Bangladesh along the coastline of 580 km could go under the sea. Agriculture dominates the country's economic development, accounting for ~20% of gross domestic product (GDP) and employing roughly 65% of the workforce. The saline water extended inland owing to the high amplitude tidal surges of 0.6-6 m. Tropical cyclone intensities have increased to more extensive damage to the crops. Climatic predictions indicate that the susceptibility of coastal areas in the future climate scenarios would likely rise due to cyclone-induced surges and that the central portion of the southern area of Bangladesh will be the most impacted. Crop yields in this area are projected to decline by up to 60%. Notably, the study projected that the climate change vulnerability indicates that severe flooding, saline water intrusion, and rising sea level would decline national rice production by 3.9% each year or a cumulative total of 80 million tons between 2005 and 2050. There are two options to minimize the impacts named mitigation and adaptation. It is needed to be considered both mitigation and adaptation options for Bangladesh, even though the country has very limited scope for mitigation. This is why mitigation involves global efforts to execute and adaptation is more local. As a result, effective adaptation policies and mitigation measures ought to be developed and implemented to minimize climate related impacts on Bangladesh.

This paper describes a comprehensive study of on vulnerability, hazards and adaptive capacity to climate threats in coastal areas and communities of Bangladesh. Coastal areas are vulnerable to sea-level rise (SLR), storm surges and flooding due to their (i) exposure, (ii) concentration of settlements, many of which occupied by less advantaged groups and (iii) the concentration

of assets and services seen in these areas. The objective of the paper is (i) to evaluate current evidence of coastal vulnerability and adaptive capacity and (ii) to compare adaptation strategies being implemented in Bangladesh. The followed approach for the case evaluation is based on (i) documenting observed threats and damages, (ii) using indicators of physical and socioeconomic vulnerability and adaptive capacity status and (iii) selecting examples of successful responses. Major conclusions based on (a) the study show the vulnerability, adaptive capacity and implementation of responses, (b) innovative community-based and ecosystem-based adaptation and (c) early warning systems are key approaches and tools to foster climate resilience. A recommendation to foster the resilience of coastal communities and services is that efforts in innovative adaptation strategies to sea-level rise should be intensified and integrated with climate risk management within the national adaption plans (NAPAs) in order to reduce the impacts of hazards.

Keywords

Climate Change; Vulnerability; Adaptability; Coastal Zone.

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Engineering Design, Fabrication and Performance Evaluation of a Pyrolysis Reactor

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Abstract

Environmental issues brought on by waste plastics often include groundwater contamination and climate change. Reactors have proven to be a reliable method for controlling these wastes through pyrolysis. In this paper, a continuous reactor is designed to pyrolyse waste plastics into wealthy materials. To the best of the researcher's knowledge, the wealthy materials produced are unprecedented owing to their phases in any batch of reaction. The reactor consists of three sections: 1) inlet, 2) main chamber and 3) outlet. The main chamber with length of approximately 40 cm, a reactant velocity of 20-25 m/s and a volumetric flow rate 0.5-1 m3/s. Single-phase products of varying crystalline and amorphous structures are produced at the earliest minimum optimum conditions of 350-600 °C reaction temperature and 100-200 min residence time. These valuable products are applicable in a wide range of applications, including the civil engineering and building sectors.

Keywords

Waste Plastics; Climate Change; Design; Continuous Reactor; Pyrolysis; Wealthy Materials; Construction.

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Effect of Damping and Stiffness on the Stability of Structures

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Abstract
The negative stiffness is the reactive force that is in the same direction as the applied force and instead of resisting, assists the deformation. The reactive force and the deflection are linearly dependent on each other. The potential energy of such a system is always negative. The negative stiffness absorbs a large amount of energy during impact or earthquakes. Force-displacement relationship of the negative stiffness shows an increase in the displacement with decreasing force. The unstable negative stiffness element can absorb a huge amount of energy. Similarly, negative damping pumps energy instead of dissipating the energy as in the case of positive damping. The response shows that the negative damping provides better stability in finite time, but the amplitude of oscillation increases with time $t \to \infty$. Pneumatic springs and magnetic dampers will be suitable for applications in the development of earthquake-resistant structures. In the future due to the robustness and ease of manufacturing of the pneumatic springs and magnetic dampers, both will be popular for vibration control of civil structures, and bridges, and also for defense applications.

Keywords
Negative Stiffness; Negative Damping; Vibration; Energy

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Tensile Stress of Overhead Conductor Function of H/W Parameter: Experimental and Methodology

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Abstract
Infrastructures are around the world and they have a great impact on human life as well as on the country economy. One of the infrastructures is the power line transmission which failure has many consequences in daily life. This infrastructure is mainly composed of towers and an overhead conductor which is the main part as it is the only which carries electricity. The fatigue of the overhead conductor is caused by the combination of many stresses in the wires such as the tensile and the bending stress. The bending stress is generated by the cyclical movement during aeolian vibrations and the tensile stress is due to the stretching load during the lunch of the overhead conductor on the power line tower. It is well known that the increase in conductor tensile load leads to an increased incidence of fatigue failure. The present study aims to evaluate the mechanical tensile stress applied on the overhead conductors as a function of the parameter H/w, where H represents the conductor stretching load and w its linear weight. Three different values of the H/w parameter (1820, 2144, and 2725 m) were used with two overhead conductors which are the ACSR Tern and the AAC Orchid. The evaluation of the tensile stress is realized through static tests of overhead conductors and experimental were collected using strain gages. The use of the formulation that relates the H/w parameter with the stress level on the external layer of the conductor was verified. The static tests were realized on the laboratory of fatigue and structural integrity of the conductor at the University of Brasilia. The proposed formula to calculate the tensile stress knowing the H/w value correlates with the experimental data. Data have shown errors of less than 10% compared to the calculated tensile stress of both conductors. The presented data could be helpful in the simulation of conductor fatigue which can lead to a good understanding of this phenomenon as well as to the maintenance of overhead power line transmission.

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Strategy to Drive Construction Robotics in Latin America

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Abstract
Population growth implies a high demand for affordable housing for the next few years. This is especially true in Latin America. So, construction robotics are crucial to driving affordable housing in the region. This lecture aims to suggest strategies for construction robotics to drive affordable housing. It developed the research method in three key steps. First, the theoretical step was a literary review using the PRISMA method. Second, an analytical framework that identifies three researches constructs: construction robotics, affordable housing, and resilient design. Finally, the result was a driving strategy to be applied in the construction field that gives opportunities to develop affordable housing using construction robotics.

Keywords
Construction Robotics; Affordable Housing. Latin America; Resilient Design.

Use of RPAS (Drones) for Old Civil Constructions and Useful Heritage Elements

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Abstract

Using of remotely piloted aircraft system (RPAS), better known as drones, has spread with multiple and very diverse applications on last years. It includes civil engineering structures inspections. From an inspection of an old bridge this conference was born precisely. The inspection was conducted by the author experimentally, in order to demonstrate that the aircraft can serve as a quality tool to make this work thatis being carried out by qualified personneland expensive auxiliary means currently. At the end, the author tryes to demonstrate that we can obtain identical or even better qualityresults, reducing the health and safety risks for the workers who do that work, with time and costssignificant savings.

At the same time, we have inspected an old bridge because many disused civil constructions can be reused to adapt to new demands. This would be a technical challenge, it can safeguard many structures already built and it can lead to interesting economic savings.

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Effect of Facia of Behavior of Back-To-Back Walls for Bridge Approaches

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Abstract

Different wall facia are used to retain backfill in Mechanically Stabilized Earth (MSE) structures. Commonly used wall facia include wrap-around, segmental-block, and full-length panel. Wall facia not only determines the aesthetics of the retaining walls, but also have influence on the behavior of MSE walls. Back-to-back MSE walls have several applications in the case of railroad bridge embankments or two-to-four lane highway bridge approach embankments.Federal Highway Administration (FHWA) guidelines discusses only briefly on design of reinforced back-to-back walls.In the present study, the effect of three types of wall facia on the behavior of back-to-back MSE walls is studied through numerical modeling. Reinforcements of back-to-back walls extend from one wall facing to the other.The kinematics of deformation of these facia under gravity loading is detailed in the study. The variations of lateral pressures, vertical stresses, and lateral deformations at the facing in back-to-back MSE walls are analyzed. The influence of the reinforcement stiffness is studied by considering three reinforcement stiffness values equal to 500 kN/m, 5000 kN/m, and 50,000kN/m. The results from back-to-back walls are compared to those of single wall. It is observed that the lateral pressures decrease as expected with reduction in stiffness of wall facing. In addition, the stiffness of reinforcement is found to have an insignificant influence on the lateral pressures in the wrap-aroundfacia, while it has significant effect in the case of full-length panel walls.

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A Brief Insight of the Infrastructure Sector in India

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Abstract
Infrastructure development is one of the important components in the development of any country. Without proper infrastructure it is not possible to give either security or competencyto others. India's infrastructure services are slow, but steadily developing realm.From ancient to thepresent, India faces different ups and downs in infrastructural development.After getting independence, India increased focus on safety and sustainable development in infrastructure. It drives the demand for safer traffic management technology, research, and know-how. Green and sustainable investment and financing parameters are of increasing importance to overseas investors.Across the sectors ranging fromthatched houses to digital houses, bullockcarts to aeroplanes and rockets, postal communication to video calling, subjected to economic regulation wherever necessary. Governments at both central and state levels are actively engaged in managing this transition, devising appropriate policy frameworks, and establishing suitable institutions such as the Central Road Fund (CRF) and Independent Regulatory Authorities (IRA) in power and telecommunication sectors.Better infrastructure leads toincrease in lifestyle towards modern civilization. In this scenario it is very important to analyze the infrastructural development and compare in various fields to overcome the drawbacks and initiate the motivation towards sustainable development.

Keywords
Infrastructure; Ancient, Modern; Civilization

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Characterization of Chemical Properties and Aging Resistance of Asphalt Binder Modified By Wood-Based Bio-Oil

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Abstract

More than 94% of the roads all around the world are surfaced using asphalt pavement which is produced through mixing aggregates (93-96%) with petroleum-based asphalt binder (4-7%). Maintenance and rehabilitation of existing roads, and construction of new roads lead to high demands for the production of asphalt mixture. Construction of asphalt pavement contribute to greenhouse gas (GHG) emissions in the United States in three main phases. Phase one, the emissions from the extraction and processing of raw materials i.e. asphalt binder, aggregate, and modifiers. Phase two, the emissions from transportation of raw materials. Phase three the emissions from mixing, production, and placement of asphalt mixture. A national goal is set to reduce GHG emissions and achieve net zero by 2050 in the United States. The same goal is set for the construction industry. Reusing and recycling materials, reducing the use of raw materials and material optimization, and using carbon sequestering materials are three main techniques that can help with reducing carbon footprint of asphalt pavement. Bio-oil obtained from biomass is a sustainable material with a low viscosity that has a good compatibility with asphalt binder. Therefore, it is used to partially replace petroleum-based asphalt binder. A huge amount of wood and forestry waste are produced and landfilled each year. The use of wood-based bio-oil (WBBO), obtained through the pyrolysis process, helps with recycling wood waste and reducing the use of raw materials in pavement construction, thus promoting sustainability. In this study, two different grades of asphalt binder, PG 64-22 and PG70-22, were used. WBBO was sourced locally in the state of North Carolina. Tests were performed to determine viscosity, density, and chemical composition of WBBO. Asphalt binders were mixed with five percentages (0, 5, 10, 20, and 50%) of WBBO. Fourier-transform infrared (FTIR) spectroscopy was used to evaluate aging resistance of modified and unmodified samples. Furthermore, rotational viscosity (RV) and Dynamic Shear Rheometer (DSR) were used to evaluate viscosity, dynamic modulus, and phase angle of the prepared samples.

Keywords

Asphalt Binder; Bio-Oil; Aging.

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Plastic Hinge Length Requirements in Reinforced Concrete Couple Shear Wall Buildings for Seismic Reinforcement Detailing

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Abstract

Proper reinforcement detailing in plastic hinge regions is one of the important measures that could help damage control of structural walls subjected to any severe earthquake event. Inelastic curvatures are commonly assumed to be uniform over a height called plastic hinge length. Non-linear dynamic analyses are performed on a set of couple shear wall buildings of simple configurations but different heights. Inelastic curvatures are calculated on numerous heights of the all the buildings and plotted along the height of the buildings. Plastic hinge lengths are estimated with the yield curvatures from analytical results. It becomes a common practice to estimate the plastic hinge length equal to 0.5 to 1.0 times the wall length, which basically were developed from experimental studies on beam and column elements. As per Canadian standards CSA A23.3-04, the requirements to calculate plastic hinge lengths are same for both cantilever and couple shear walls, i.e., 1.5 times the wall length in the direction under consideration. Results from the present study shows that inelastic curvatures are not uniform over the plastic hinge length and Canadian requirement to calculate plastic hinge length is unconservative for couple shear wall and more critical for slender couple shear walls. A new multiplication factor is proposed for safe estimation of plastic hinge length for couple shear walls of medium and high rise reinforced concrete buildings. Results indicate that it needs to consider 2.0 times wall length instead of 1.5 times wall length in the direction under consideration for couple shear plastic hinge length calculations.

Keywords

Reinforced Concrete; Buildings, Couple Shear Wall; Non-Linear Dynamic Analysis; Plastic Hinge; Seismic Design; Inelastic Curvatures; Damage Control

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Correlation among S-wave Velocity Structures, Physical Property Structures and Mineral Assemblages in Strong Weathered Andesite Rock Mass along under Constructing Road

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Abstract

In area where strongly weathered volcanic rocks are distributed,slope slide often occur both during and after construction of cut slope, even in the absence of remarkable external force. Many road cut slopes constructed at volcanic rock layer of Kanmon Formation in Yamaguchi Prefecture, western Japan collapsed in past decades.

The volcanic rocks in Kanmon Formation were strongly weathered like as lateritic facies. The physical property structure of this strong weathered volcanic rocks reflects the mineral assemblages of rocks and weathered soils which were formed weathering processes.In many road and railway construction sites, physical properties of ground which are affected the degree of weathering, are assessed by borehole and drilling cores.However, drilling explorationneeds great efforts and expense, then we must establish easier and cheaper method adapting underground survey.In this aspect, we tried to measure S-wave velocity using microtremor array measurements to grasp the weathering and geophysical profile of underground at the road constructing site on Kanmon Formation. In the results, it is concluded that the S-wave velocity of ground obtained from microtremor array measurements agree with that of rock pieces by ultra-sonic wave test, and that the S-wave velocity structure getting from microtremor array measurements willillustrates the profile of weathering and physical properties in underground.

The Use of AI to Predict Important Variables in Complex Construction Problems

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University of Stavanger, Norway

Abstract

Torgeir Selsøyvold has studied the behavior ofunbonded tendons that are widely used in prestressed concrete bridges and buildings due to their economical construction methods and good durability resulting from their corrosion resistance.

Existing design guidelines, codes, and literature provide different calculation models for estimation of the ultimate stress in the pre-stressing steel when failure.

Most of the existing methods are based on theoretical (e.g., collapse mechanism and bond-reduction models) and statistically-based empirical models, with only a few or no surrogate models based on artificial neural networks (ANNs). In his presentation he will presents his development of an ANN-based model to predict stress in unbonded tendons at the ultimate limit state.

The predictions from the ANN-based model show very good agreement with the experimental results given in the literature during training, testing, and validation. A sensitivity analysis has been performed to quantify the degree of influence of the input variables used in the developed ANN model. The analysis shows that the predictions of tendon stress using neural networks are more accurate than those results obtained using the models given in the design guidelines and the literature.

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Implementation of Riverside Defenses for the Prevention of Floods Due to the El Niño Phenomenon in Peru

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Abstract

The phenomenon of El Niño, is that natural phenomenon that in South America, produces changes in rainfall, being Peru, the Peruvian Coast affected by floods, because these rains increase the flows of the rivers, for this reason a solution is proposed , which is the design of gabions, since the design of retaining walls based on gabions, are resistant and allow the sustainable development of our Environment, due to the fact that their filling materials are reusable, durable and economical and can be used taking advantage of the boulders in the study area. This gabion design is important for agricultural areas that are affected by flooding and also urban areas, since on the Peruvian coast the ground level is flat and for this reason floods occur. This type of riparian defense is the best structural solution.
Key Words: El Niño Phenomenon; Gabions; Retaining Wall; Riverside Defense

Poster Presentation

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Climate Change Effect and Sea Level Rise Analysis in Coastal Communities of Bangladesh

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Abstract

Bangladesh is one of the most impacted countries by climate change.The sea-level rise leads to increasing incidences of tropical cyclones, storm surges, floods, nor' westers, salinity effect, droughts, and tornadoes. Climate change and sea-level rise have devastated coastal ecosystems and the local economy, causing massive panic throughout the nation.Studies show that global warming and climate change create a significant threat to Bangladesh. It is projectedthat by 2050 part of Bangladesh along the coastline of 580 km could go under the sea. Agriculture dominates the country's economic development, accounting for ~20% of gross domestic product (GDP) and employing roughly 65% of the workforce.. The saline water extended inland owing to the high amplitude tidal surges of 0.6-6 m. Tropical cyclone intensities have increased to more extensive damage to the crops.Climatic predictions indicate that the susceptibility of coastal areas in the future climate scenarios would likely rise due to cyclone-induced surges and that the central portion of the southern area of Bangladesh will be the most impacted.Crop yields in this area are projected to decline by up to 60%.Notably, the study projected that the climate change vulnerability indicates that severe flooding, saline water intrusion, and rising sea level wouldddecline national rice production by 3.9% each year or a cumulative total of 80 million tons between 2005 and 2050. Furthermore, deteriorating infrastructure exacerbates climate change: failing embankments and malfunctioning sluice gates, complicating water management, and amplifying the consequences of floods, droughts, cyclones, and waves. This study is aimedto identify the vulnerability and viable livelihood adaptation solutions for coastal Bangladesh. Hence, this study assessed the climatic and environmental hazard risk to the communities living in southern areas of the coastal belt. Remote sensing (RS) and geographic information system (GIS) techniques are being used to identify the vulnerabilities and adopt strategies including alternate livelihood to suit the changing coastal environment.

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